

## SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS  
DURING JULY, 1927

By HERBERT H. KIMBALL

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements the reader is referred to the REVIEW for January, 1924, 52:42, January, 1925, 53:29, and July, 1925, 53:318.

From Table 1 it is seen that solar radiation intensities averaged above the July normals at all three stations.

Table 2 shows an excess in the total solar radiation received on a horizontal surface from the sun and sky at all three stations for which normals have been determined, which was pronounced at Madison and Lincoln.

Skylight polarization measurements made at Washington on two days give a mean for 56 per cent, with a maximum of 57 per cent on the 28th. At Madison measurements obtained on seven days give a mean of 57 per cent, with a maximum of 69 per cent on the 2d. These are close to the corresponding averages for July at both Washington and Madison.

TABLE 1.—Solar radiation intensities during July, 1927

[Gram-calories per minute per square centimeter of normal surface]

## Washington, D. C.

Date	Sun's zenith distance											Local mean solar time
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon	
	75th mer. time	Air mass										
		A. M.					P. M.					
		e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.
July 1	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.	
5	9.83					1.27	1.02	0.90			14.10	
12	7.57		0.80	0.95	1.13	1.39					11.38	
13	17.96					1.20					19.59	
20	20.57			0.75							22.00	
26	16.20					0.83					13.13	
27	16.79					0.78					16.79	
28	16.79				0.73	0.99					17.37	
Means			(0.80)	(0.85)	(0.93)	1.08	(1.02)	(0.90)				
Departures			+0.14	+0.08	+0.04	-0.09	+0.04	+0.12				

## Madison, Wis.

July 1.	17.37			0.77						16.79
2.	10.59				1.24	1.44				10.59
6.	13.61		0.91	1.02	1.18	1.38				17.96
18.	11.81				1.11	1.34				12.24
19.	7.87					1.39				9.47
20.	8.18				0.98					8.81
23.	11.81					1.30				10.21
25.	11.81				0.92	1.20				12.24
26.	13.61				0.89					13.13
27.	13.13				0.93	1.14				12.24
28.	16.20				1.16	1.23				17.37
29.	10.97				1.10	1.31				8.81
Means			(0.91)	(0.90)	1.06	1.30				
Departures			+0.14	+0.00	+0.01	+0.02				

## Lincoln, Nebr.

July	Sun's zenith distance											Local mean solar time	
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon		
75th mer. time	Air mass										Local mean solar time		
	A. M.					P. M.							
	e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.		
1	14.10					1.40	1.23	1.08	0.97		12.24		
2	11.38				1.04	1.19	1.36				10.97		
3	9.47					1.32	1.09	0.91	0.77	0.65	12.24		
4	13.61		0.79	0.93	1.15	1.35					13.13		
7	11.38			1.17	1.31	1.46					11.38		
8	11.38			0.93	1.09		1.10				12.24		
9	13.61					1.39	1.17	0.99	0.84		12.24		
23	10.97				1.09	1.28					9.83		
25	12.68				1.01	1.18	1.38				12.08		
26	12.68				0.84	1.00	1.14	1.35	1.03	0.82	13.61		
27	15.65				0.77	0.90	1.11	1.33			14.60		
Means			0.80	1.00	1.16	1.36	1.12	0.95	0.81	(0.65)			
Departures			+0.00	+0.10	+0.08	+0.03	+0.06	+0.07	+0.07	-0.07			

1 Extrapolated.

TABLE 2.—Solar and sky radiation received on a horizontal surface

[Gram-calories per square centimeter of horizontal surface]

Week beginning	Average daily radiation						Average daily departure from normal		
	Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Washington	Madison	Lincoln
1927	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
July 2	513	586	667	583	441	719	+37	+50	+87
9	456	475	568	384	370	750	-24	-57	-23
16	419	523	558	387	271	727	-49	+11	-18
23	516	557	591	467	374	607	+47	+68	+50
Deficiency since first of year on July 29							-7,630	-4,424	-5,285

## POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. Edwin T. Pollock, Superintendent U. S. Naval Observatory]

[Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, and Mount Wilson observatories]

Date	Eastern standard civil time	Heliographic		Area <sup>1</sup>	
		Longi- tude	Latitude	Spot	Group
1927					
July 1 (Naval Observatory)-----	h. m.	°	°		
	11 47	-60.5	+15.0	93	
		-49.0	+16.5		340
		-4.0	-9.0		31
		+9.0	-8.0		432
		+46.0	+22.0		123
		+75.0	+21.0	62	
July 2 (Naval Observatory)-----	11 50	-66.5	-10.0	15	
		-48.0	+14.5		31
		-37.0	+16.0		370
		+22.5	-8.0		463
		+32.5	+23.5		46
		+58.0	+22.5		154
July 3 (Naval Observatory)-----	11 58	-52.5	-10.0	15	
		-34.0	+14.5		15
		-23.0	+16.0		432
		+35.5	-8.0		494
		+44.0	+23.0		62
		+72.0	+22.5		139
July 4 (Naval Observatory)-----	11 47	-77.0	-11.0		62
		-39.0	-10.0	12	
		-10.0	+15.5		370
		+49.0	-8.0		463
		+59.0	+22.5		62
July 5 (Naval Observatory)-----	11 53	-63.0	-11.0		62
		-53.0	-7.5	15	
		-25.0	-10.0	12	
		+4.0	+15.5		401
		+64.0	-8.0		463
		+73.0	+22.5		62
July 6 (Mount Wilson)-----	10 30	-46.5	-10.0		10
		+16.5	+14.0		737
		+78.0	-7.5		294
July 7 (Naval Observatory)-----	12 10	-37.0	-10.5	31	
		-26.5	-7.0	15	
		+12.5	-10.5		15
		+30.0	+15.0		432
		+62.0	+21.0		31
July 8 (Naval Observatory)-----	11 47	-72.0	-11.0	46	
		-22.0	-12.0	15	
		-13.5	-8.0		15
		+44.0	+17.5		401
July 9 (Mount Wilson)-----	40 30	-75.0	+25.0	3	
		-59.5	-7.0	14	
		-50.0	-22.5		10
		-5.0	-9.0		30
		+2.0	+12.5		2
		+56.0	+14.0		448
July 10 (Mount Wilson)-----	9 50	-63.0	+25.0	2	
		-46.0	-7.0	11	
		-37.0	-23.5		8
		-7.5	-8.5		27
		+17.0	+12.5		3
		+71.0	+14.0		240
July 11 (Naval Observatory)-----	11 52	-32.0	-7.5	15	
		-22.0	-23.0	9	
		+84.0	+16.0		309
July 12 (Naval Observatory)-----	11 50	+37.0	+10.5		31
July 13 (Naval Observatory)-----	11 48	-72.5	-12.5	123	
		+52.0	+10.5		19
July 14 (Naval Observatory)-----	11 42	-68.0	-14.0	15	
		-59.0	-13.0	216	
July 15 (Naval Observatory)-----	11 57	-71.0	-30.5	62	
		-55.5	-14.0	12	
		-46.5	-13.0		216
		-11.5	+14.0		46
July 16 (Naval Observatory)-----	11 43	-60.0	-30.5		15
		-32.0	-12.5	154	
		+2.0	+14.5		77
		+50.5	-12.0		108

<sup>1</sup> Areas are corrected for foreshortening and are expressed in millionths of Sun's visible hemisphere.

## Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic		Area	
		Longi- tude	Latitude	Spot	Group
1927—Continued					
	<i>h.</i> <i>m.</i>	<i>°</i>	<i>°</i>		
July 17 (Mount Wilson).....	9 40	-47.0	-30.0	-----	12
		-19.0	-12.0	-----	237
		+14.0	+15.0	-----	26
		+63.0	-12.0	-----	20
July 18 (Naval Observatory).....	11 42	-6.0	-12.5	-----	185
		+27.0	+14.5	-----	31
July 19 (Mount Wilson).....	12 8	-78.0	+23.5	98	-----
		-39.5	-10.0	-----	7
		+9.5	-11.0	-----	170
July 20 (Naval Observatory).....	11 42	-63.5	+23.0	93	-----
		+20.5	-11.5	93	-----
		+25.0	-15.5	15	-----
July 21 (Naval Observatory).....	11 41	-80.0	-9.0	309	-----
		-50.0	+23.0	123	-----
		-11.0	-9.5	-----	62
		+36.0	-14.5	-----	93
July 22 (Yerkes).....	18 0	-35.0	-8.0	25	-----
		-65.0	+24.5	75	-----
July 23 (Naval Observatory).....	11 43	-55.0	-9.0	-----	370
		-24.5	+23.0	123	-----
		+17.0	-9.5	-----	93
		+24.0	+10.0	-----	15
		+64.0	-15.0	-----	185
July 24 (Naval Observatory).....	11 44	-42.5	-8.5	-----	340
		-11.0	+23.0	108	-----
		+29.5	-9.5	-----	46
		+39.0	+9.0	-----	93
		+75.0	-19.0	12	-----

## Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic		Area	
		Longi- tude	Latitude	Spot	Group
1927—Continued					
July 25 (Naval Observatory)-----	h. m.	°	°		
	11 52	-29.0	-8.5	-----	340
		+1.0	+23.0	-----	108
		+42.0	-9.0	-----	93
		+52.0	+9.0	-----	77
July 26 (Naval Observatory)-----	11 46	-17.0	-9.0	-----	370
		-2.0	+14.0	-----	15
		+14.0	+23.0	-----	108
		+55.5	-9.5	-----	108
		+64.5	+9.0	-----	93
July 27 (Naval Observatory)-----	11 50	-69.0	-8.0	-----	77
		-2.5	-9.5	-----	340
		+13.0	+14.0	-----	46
		+27.5	+23.0	-----	77
July 28 (Naval Observatory)-----	11 49	+70.0	-10.0	-----	62
		-56.0	-8.0	-----	31
		+11.0	-9.5	-----	309
		+29.5	+13.5	-----	15
		+40.5	+22.5	-----	77
July 29 (Yerkes)-----	10 19	+70.0	-17.0	-----	9
		+42.0	-29.0	-----	25
July 30 (Yerkes)-----	12 16	+27.0	+11.5	-----	75
		+66.5	+3.5	-----	10
		+30.5	-21.5	-----	75
July 31 (Naval Observatory)-----	13 26	-15.0	-7.5	-----	15
		+23.0	+10.5	-----	46
		+52.0	-9.5	-----	340
		+81.0	+22.5	-----	309

## AEROLOGICAL OBSERVATIONS

By W. R. STEVENS

Average free-air conditions for July, as determined by kites and given in Tables 1 and 2, show close agreement with the normal, except for subnormal temperatures observed at all levels at Ellendale and Royal Center. The airplane station at Washington shows positive temperature departures at all levels. However, only a three-year mean is available at this station. The free-air wind resultants show a slightly more than normal northerly component at Broken Arrow, Ellendale, and Royal Center, and a more southerly component at Due West and Groesbeck.

Easterly winds at high levels were observed at many stations as far north as Ithaca, where a northeast wind of 17 m. p. s. was reported at 10,000 meters on the 1st. They were frequent enough over Key West and San Juan to give an east component in the resultants at all altitudes, and at nearly all altitudes over Groesbeck.

A remarkable pilot-balloon record for the month was made at Medford, Oreg. Sixty-one observations were made, the lowest reaching 4,000 meters. Forty-three of the observations extended to 10,000 meters and 14 to 12,000 meters.

A good illustration of the effect of exchange of mass between different air layers upon the rate of ascent of a pilot balloon is given in the double-theodolite observation made at Groesbeck on the 21st. The balloon ascended with a velocity less than the standard inflation rate to an altitude of 3,600 meters, which indicated a descending current of 0.5 m. p. s. The opposite effect of convection upon the ascensional rate of pilot balloons has been very frequently observed, but descending currents are of much larger cross section than ascending currents; consequently the former have a much lower velocity than the latter, and the observations less frequently prove the existence of descending currents.

Two "free-rising" captive balloon flights were made during the month. This method is quite satisfactory for obtaining free-air observations when winds are too light for kites. Instead of the balloon pulling the wire

out, as is done in kite flying, the wire is reeled out so rapidly that the balloon rises freely, except for the increasing weight of the wire. The Fergusson meteorograph is used, which is described in this REVIEW, p. 293. The ascent at Royal Center attained an altitude of 2,356 meters. A flight was also made at Due West by this method. However, just before reeling in, a kink developed when the wire came to the ground suddenly and the balloon broke away. The balloon and instrument came down undamaged about 12 miles from the station, from whence they were returned. The altitude reached was 5,437 meters.

## Meteorological conditions over Due West, S. C., on July 14, 1927

Time	Altitude (m.)	Temperature	$\frac{\Delta t}{100 \text{ m.}}$	Relative humidity	Wind	
					Direction	Velocity
	m. s. l.	° C.		Per cent		m. p. s.
11:22 a. m. ....	217	28.2	-----	68	WSW	4.5
11:53 a. m. ....	666	22.8	1.20	77	W	8.0
12:05 p. m. ....	1,121	21.5	0.29	66	W	8.3
12:29 p. m. ....	1,676	17.8	0.67	67	WNW	6.4
1:11 p. m. ....	2,507	12.2	0.65	67	W	8.8
1:33 p. m. ....	1,576	18.1	0.49	70	W	7.2
1:40 p. m. ....	1,001	20.9	1.10	88	W	5.0
1:44 p. m. ....	665	24.6	1.43	74	W	4.9
1:49 p. m. ....	217	31.0	-----	60	SW	4.0

An unusual number of thunderstorms occurred during the month in the South Atlantic and East Gulf States, Due West reporting them on 22 days, with a total rainfall of 6.61 inches. Thunderstorms which occurred in the afternoon of the 14th in Georgia, South Carolina, and North Carolina are of a type which frequently occur in the Southeast. On this date pressure was high off the South Atlantic coast. The aerological chart shows that the air, to at least moderate altitudes, had come from the Gulf and was very moist. Therefore, in the absence of inversions, a relatively small increase in the surface temperature would produce